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SPADE PERFORMANCE TEST PLANNING: DATA GATHERING AND EXTRACTION --ETC(U)
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SPADE PERFORMANCE TEST PLANNING: Data Gathering and Extraction for the Shore Based Tests

FOREWORD

This document is one of several written to describe in detail the plans for evaluating the performance of the Sonar Processing and Display Equipments (SPADE) at NEL. The specific subject of this memorandum is data gathering and extraction for these tests.

The contents were developed in cooperation with:

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The memorandum was written primarily for those actually involved in the SPADE testing program. However, it also serves the purpose of informing others interested of the types and volume of data which will be available from the testing.

OUTLINE

I. INTRODUCTION

This memorandum is intended as a working document which describes the data required to evaluate the SPADE and to suggest procedures for their extraction from the test complex. The extracted data is stored on magnetic tape for the purposes of permanent storage and off-line machine analysis. This is the appropriate time to produce such a document since the information is required for the development of the data extraction computer program. Although the comments are oriented towards shore testing in ASDEC, the carryover to the sea environment should be apparent.

The computer data extraction program provides for the option of collecting data or not collecting data. When data is to be collected, the program will provide for the ability to select one of three groups of data. They are:

Group I data consists of target position and amplifying information from the synthesizer (test generation) and the SPADE operator entries and selected computer/hardware processed information (test subject).

Group II data consists of Group I data plus "window processing" statistics. "Window processing" is a technique which provides SPADE with a semi-automatic detection capability. The technique consists of the general purpose computer dividing the ocean under surviellance into overlapping (50% overlap) areas (windows)

of investigation: presently, each window covers 100 yards in range and 15 degrees in bearing. The computer surveys the contents of the windows looking for consistency in amplitude and doppler in the data words obtained from the sonar signal processor (SSP). Words which exceed a threshold value on both parameters are formed into Event Symbol words for subsequent display on the Sonar Detection Display (SDD).

Group III data consists of Group I data plus Data Words from the Sonar Signal Processor (SSP). Data Words describe the sonar signal in terms of range, bearing, amplitude and doppler.

This document devotes itself primarily to Group I data since the addition of either "window processing" statistics or Data Words present no problem. The words are well defined and they can be extracted in blocks referenced to the ping number in which they occurred.

The following sections provide the details for gathering and extracting the desired information. Section II provides an overview of the data extraction program. Section III provides a simplified block diagram of SPADE's shore test configuration. Section IV describes the programming requirements.

II. OVERVIEW OF THE DATA EXTRACTION PROGRAM

The SPADE data gathering and extraction program is summarized in the following comments:

1. The USQ-20 will provide two 500-word output buffers for gathering the data to be transmitted to magnetic tape.

2. The USQ-20, upon receiving data from test generation (synthesizer) and the test subject (SPADE), will produce a message indicating the kind of information and the number of words in the message. When required, the time (LSB = 1 sec) of the message is also included.

3. The messages as they are formed will be put in one of the output buffers for subsequent transmittal to magnetic tape. When this buffer becomes full, an internal interrupt will be generated which informs the computer to start outputting to a magnetic tape unit. To insure no lose of data, the interrupt also causes the initiation of the second output buffer. Test data is directed to this buffer until it in turn becomes full and the cycle starts over.

4. Initially, the data put on magnetic tape will all be in chronological order. They will be amplified by the date, ping number and run number (referenced to a given test). Typically, the Group I data format for magnetic tape must contain the following information:

Date

Test Number

Run Number

Start of Test Time

End of Test Time

Ping Number (referenced to interrupt 4 = start of dwell)

Summary/Status Data

Performance Data

5. The data designated for extraction will be formed into messages prior to being placed in the output buffer. Each message will contain the following information:

a. The number of 30-bit words in the message.

b. The type of information.

c. When required, the time (LSB = 1 Sec).

d. The data.

6. The general control coding for the data-output messages is as follows:

Bits 29-27: category (number of words in a message)

0 = 9 words octal code

1 = one word

2 = two words

.

:

7 = seven words

26-22: type of information (see Table 1 for the coding)

21: time tagged (1)

20-0: time (LSB = 1 Sec)

TABLE I

Message Structure for Magnetic Tape Storage

Information	Octal Code	#Words/Message	Time Tagged
Synthesizer Target Position Data	12	3, 5, 7 or 9*	Yes
Synthesizer Target Signal Characteristic	13	2, 3, 4 or 5*	Yes
SDD Operator Entries	5	2	Yes
HRD Operator Tracking Entries	7	2	Yes
HRD Operator Classification Entires	11	2	Yes
Area Designator Word$_1$	14	2	Yes
Area Designator Word$_2$	15	2	Yes
ACME Operator Entries	16	2	Yes
Computer Classification Processing	17	3	Yes
Computer Track Processing	20	3	Yes
The SPADE Ship's Vector	21	2	Yes
Interrupt 1	1	1	Yes
Interrupt 2	2	1	Yes
Interrupt 3	3	1	Yes
Interrupt 4	4	1	Yes
SDD Opstatus Word	6	2	Yes
HRD Opstatus Word	10	2	Yes
Threshold Word	22	1	No
Desired Number of Events	23	1	No
Number of Events	24	1	No
Number of High Amplitude Events	25	1	No
Number of Medium Amplitude Events	26	1	No
Number of Low Amplitude Events	27	1	No
Long Delay Time Bit Set Per Beam	30	2	No
Event Processing Mode	31	1	No

*The different values reflect the number of tracks in the system (1, 2, 3 or 4).

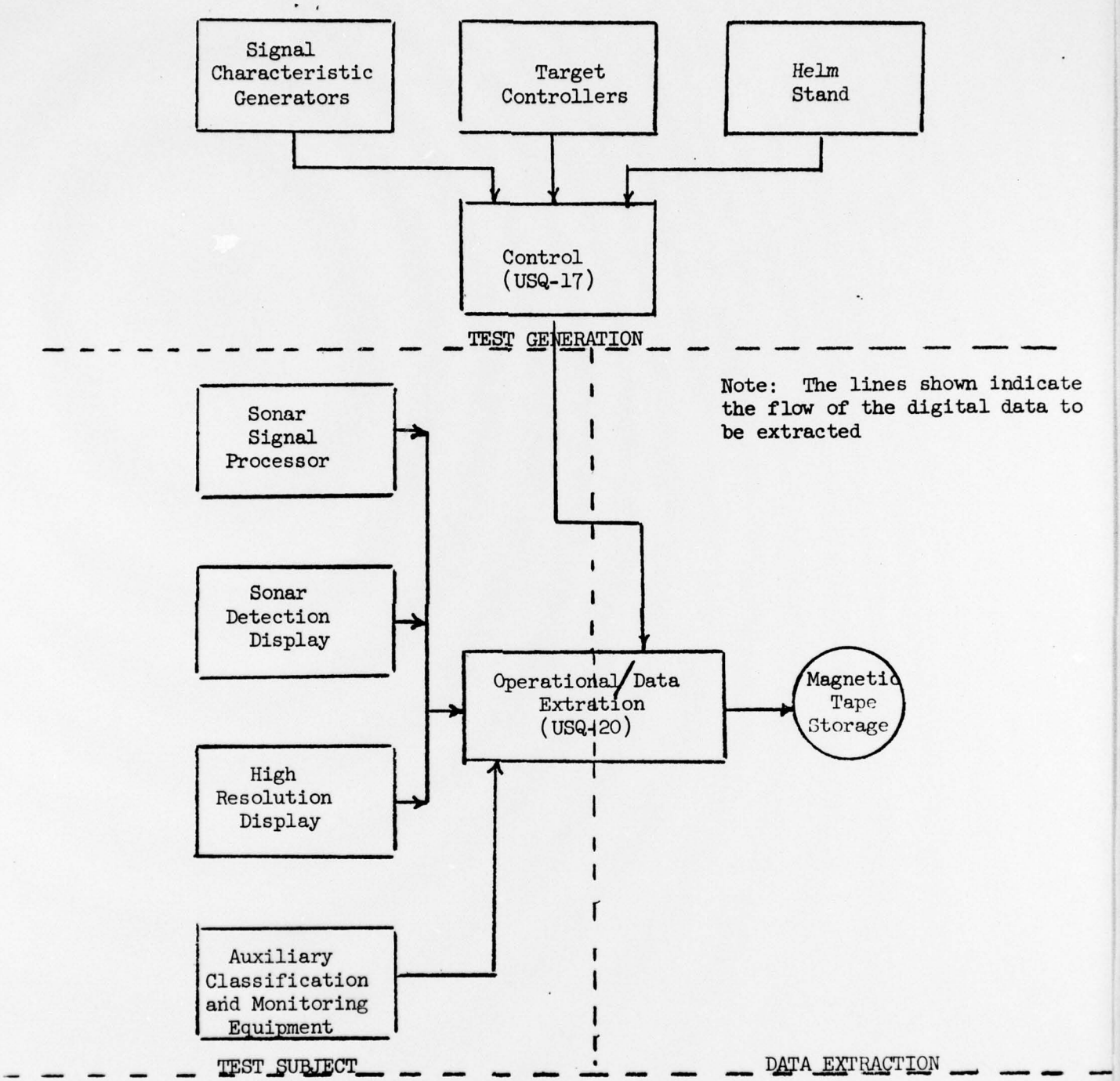

FIGURE I. Simplified Block Diagram of the SPADE Test Configuration

III. SPADE's BASIC TEST CONFIGURATION

The basic SPADE test configuration consists of the following major equipments:

1. Target Controllers (4)
2. Signal characteristic generator (includes one USQ-17 computer) (1)
3. Helmstand (1)
4. Control Computer (USQ-17) (1)
5. Sonar Signal Processor (SSP) (1)
6. Sonar Detection Display (SDD) (1)
7. High Resolution Display (HRD) (1)
8. Auxiliary Classification and Monitoring Equipment (ACME) (1)
9. General Purpose Computer (USQ-20) (1)
10. Magnetic Tape Unit (1)
11. Camera and Camera hood (2)

The above listing includes only those items which are necessary to describe the test configuration. The first 4 equipments define the test generation (synthesizer) portion of the system. The next 5 equipments define the test subject (SPADE). The last two equipments are necessary for the recording and storage of test results.

During the latter phases of testing, the synthesizer will be replaced by sonar tapes.

The simplified block diagram in Figure 1 depicts the SPADE test configuration.

IV. PROGRAMMING REQUIREMENTS

Group I Data

Group I data is common to each data group. It is composed of the data necessary to evaluate the operational functions of the SPADE. The data of this group originates in both the synthesizer and SPADE.

1. Synthesizer Data

The Target data gathered and extracted from the synthesizer represents the "true" situation. To extract this data for subsequent storage on magnetic tape requires that the USQ-17 (control computer in the synthesizer) interface with the USQ-20 (Operational Computer in SPADE).

a. General Requirements

(1) The USQ-17 will transmit data to the USQ-20 at the start and end of each recording period; at the start and end of each target maneuver and on demand (by the SPADE) in an identifiable fashion.

(2) The USQ-17 will also transmit target signal information on each target in an identifiable fashion.

(3) The USQ-20 will time tag data originating in the USQ-17.

(4) The USQ-20 will eliminate no-information words and organize the information words for subsequent transmittal to a magnetic tape.

b. Input/Output Specifications

(1) Computer provisions

(a) Both the USQ-17 and the USQ-20 will provide two channels to satisfy the interface requirement. One channel is for communications from the USQ-20 to the USQ-17. The other channel is for communications from the USQ-17 to the USQ-20.

(b) Both computers will operate in a buffer mode. The buffers have the following characteristics:

Channel	Computer	Buffer	
		Size	Direction
1	USQ-20	1-word	Output
	USQ-17	1-word	Input
2	USQ-20	9-word	Input
	USQ-17	9-word	Output

(2) Procedures

(a) The USQ-20, after it has been turned on, will stay in a cycle waiting for the sonar mode to be changed from stand-by to active or passive. Once the mode change has taken place, the following will occur:

1. The USQ-20 will record the time.

2. SPADE will send a dwell pulse to the synthesizer. This allows signal data to pass into SPADE.

3. The visual test system clocks will be reset manually.

4. If data is to be recorded, the USQ-20 will transmit to the USQ-17 a word indicating the start of the test. This also causes the USQ-17 to start all the tracks and ownship moving.

(b) In addition to the demand update at the start of the test, the USQ-20 will transmit a demand update each time a SPADE operator makes an entry and also at the end of the test.

(c) The USQ-17, upon receipt of a demand update, will update all targets and initiate a nine-word output buffer. Two words are required to update one track. The ninth word is a "header" word indicating the information content. These words are described in Section IV. 2.c.

(d) The USQ-17 will also update the targets and send the information to the USQ-20 whenever a target starts or ends a maneuver.

(e) At the end of each ping cycle (end of receive), the USQ-17 will also initiate a nine-word buffer to transmit a target signal characteristic word on each track. A header word informs the USQ-20 of the block's contents.

(f) The USQ-20 samples its input buffers each program cycle (~100 m sec). No-information words will be eliminated.

The valid data will be time-tagged and put in an output buffer for temporary storage and subsequent transmittal to magnetic tape for permanent storage.

c. Word Formats.

The formats of the words outlined in this section are only suggestions. However, it is important that their contents be preserved.

(1) USQ-20 → USQ-17

The type of demand update does not need to be recorded. Therefore, a simple signal to the USQ-17, indicating a request for the targets to be updated, is all that is required.

(2) USQ-17→ USQ-20

(a) Header Word

Bits 29-1: Spares

0: Information Code:

Target Position Parameters = 0

Target Signal Characteristics = 1

(b) Range and Bearing Word

Bits 29-16: Range LSB = $3\frac{29}{32}$ yards

15: Demand Data (1)

14-12: Track Number Code

000 = Disregard Data

001 = Target Controller 1

010 = Target Controller 2

100 = Target Controller 3

110 = Target Controller 4

11-10: Maneuver Code 00 = No Maneuver

01 = Start Maneuver

11 = End Maneuver

9-0: True Bearing LSB = $\frac{15}{32}$ degrees

(c) Speed and Course Word

Bits 29-24: Speed LSB = 1 Knot

24-15: Depth LSB = 1 Foot

14-13: Spare

12-10: Type Code 001 = SS

010 = SSN

100 = Torpedo

101 = Reef

110 = Fish

9-0: Course LSB = $\frac{15}{32}$ degrees

(d) Target Signal Characteristic Word.

Bits 29-25: Target Aspect LSB = 5 degrees

24-18: Echo Length LSB = 10 feet

17-11: Depression Angle LSB = 1 degree

10-8: Track Number

7-0: Total Attenuation

Note: Total attenuation is equal to the sum of the transmit depressions, range and receive depressions attenuations.

(3) Notes.

(a) The SPADE's ship vector will be updated by the Speed and Heading Word received from the SDD. This information will be extracted each time the targets are updated.

(b) The general procedures for grouping and time tagging the data for subsequent extraction are covered in Section II.

2. SPADE Data

The data gathered and extracted from the SPADE are of two kinds: Performance and Summary or Status Data. The extraction of this data is simplified by the fact that all the data are contained within the USQ-20 Computer and, therefore, no external interfaces are required.

a. Required data

Performance Data

SDD Operator Entries

Track Detection (includes range, bearing and track number)

Track Updates (includes range, bearing and track number)

Priority Assignment (includes track number)

Pointer (includes range and bearing)

Lost Contact Indications (includes track number)

Drop Track Commands (includes track number)

Clear Pointer Commands

Updating Operating Status*

- Pulse Length
- Range Scale
- Threshold Mode
- Display Density
- Sonar Mode
- Display Sequence
- Range Resolution

Backup Classification (includes track number)

HRD Operator Entries (Both Tracking and Classification Entries)

Track Updates (includes range, bearing and track number)

Track Classification (includes track number)

HRD Mode Of Off-Set*

Tracking Mode

Track Leading Edge Update (includes range, bearing and track number)

*Listed under Summary or Status Data

Lost Contact Indications (includes track number)

Pointer (includes range and bearing)

ACME Operator Entries (Includes Track Number)

Trace Length and Range Gate

Doppler

PIP Shape

Highlights

Leading Edge Alignment

Trailing Edge Alignment

Erase Last Entry

Erase All Previous Entries

Computer Track Processing Outputs (Includes Track Number)

Predicted Track Positions (range and bearing) obtain at time of first and second HRD offset

Smoothed Track Position

Tracking Logic Employed

Smoothing Constants

Range Rate

Computer Classification Processing Outputs (Includes Track Number)

(The clues listed are average based on HRD and ACME operator entries)

Trace Length

Doppler

PIP Shape

Leading Edge Alignment

Trailing Edge Alignment

Axis Angle

Track Classification

SPADE Ship's Vector

Speed

Course

Summary or Status Data

Interrupt #1 (I_1)

Interrupt #2 (I_2)

Interrupt #3 (I_3)

Interrupt #4 (I_4)

SDD Opstatus Word

HRD Opstatus Word

Threshold Word

Desired Number of Events

Number of Events

Number of High Amplitude Events

Number of Medium Amplitude Events

Number of Low Amplitude Events

Long Delay Time Bit Set Per Beam

Event Processing Mode

Since the word formats for the performance data are all well defined and the Summary or Status Data are either well defined or apparent by the nature of the data, the formats will not be restated.

b. Procedure

(1) The USQ-20, upon receiving data from an operator (SDD, HRD or ACME) or computer processing will make a one, two or three-word message (see Table 1). The first word a control word (described in Section II). The remaining words the information.

(2) The messages as they formed will be put in an output buffer for subsequent transmittal to magnetic tape (see Section II).